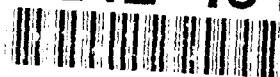


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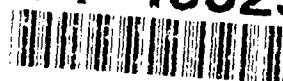


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Comparisons of Wartime and Peacetime Disease
and Non-battle Injury Rates Aboard
Ships of the British Royal Navy

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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
BETHESDA, MARYLAND



**COMPARISONS OF WARTIME AND PEACETIME DISEASE AND NON-BATTLE INJURY
RATES ABOARD SHIPS OF THE BRITISH ROYAL NAVY**

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SUMMARY

Problem

Medical resource planning requires projections of disease rates expected during combat operations. Peacetime disease and non-battle injury (DNBI) rates have been computed for forces afloat, but no medical records exist for U.S. Navy vessels during the last major naval conflict (World War II).

Objective

The present investigation seeks to contrast disease incidence of British Royal Navy crew members during World War II deployments with illness rates of Royal Navy sailors deployed on peacetime operations. The difference between wartime and peacetime rates will give a measure of the effect of combat on shipboard disease rates.

Approach

Wartime vessels selected for the analyses were all directly involved in combat but were not damaged to the extent that precluded the continuance of their operations. Ships analyzed in peacetime operations were selected from deployments occurring either immediately prior to or directly following the cessation of hostilities. Ship type was also examined as a factor in sick list admission rates.

Results

Illness rates differed among ship types with aircraft carriers having the lowest rates, followed by cruisers, battleships, and destroyers. Comparisons of wartime and peacetime illness rates for carriers, battleships, and cruisers indicated that disease incidence was lower during wartime for all ship types; these differences reached a level of statistical significance for battleships and cruisers. Several specific categories of disorders were significantly lower on wartime deployments than during peacetime operations.

Conclusions

Contrary to illness patterns expected among ground troops, rates of disease among forces afloat were lower during periods of combat than in peacetime. The implication for wartime medical requirements programming is that, aboard ships, peacetime medical resources would need only be supplemented for the expected rate of battle casualties.

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**COMPARISONS OF WARTIME AND PEACETIME DISEASE AND NON-BATTLE INJURY
RATES ABOARD SHIPS OF THE BRITISH ROYAL NAVY**

Introduction

Recent investigations have examined the effects of ship size¹ and operational status² on the rates of outpatient illness aboard U.S. Navy vessels. These studies indicated that smaller ships (destroyers, frigates) had higher rates of sick bay visits than larger ships (aircraft carriers), and that the rate of outpatient visits was lower among ships providing combat support during the Vietnam conflict than aboard ships in the years immediately following the cessation of hostilities. It was suggested that the lower illness rates on vessels during the Vietnam period resulted from less perceived need for attention to minor medical problems during combat than during peacetime, when the tempo of operations may be greatly reduced.

Medical resource planning requires projections of disease and non-battle injury (DNBI) rates among those persons requiring treatment beyond that normally associated with outpatient visits. Most outpatient visits result in treatment and an immediate return to duty; however, a number of visits will require admission to the sick list—a condition in which the crewmember is sick in quarters rather than returned to duty, while an even smaller percentage of outpatient visits will result in hospital admissions. Accurate predictions of DNBI rates during combat are critical not only for medical requirements programming, but also for manpower planning.

Peacetime hospital admission rates for forces afloat have been computed³, as have DNBI rates of ground forces serving in Vietnam⁴. However, it is difficult to quantify the effects of combat on rates of illness because no DNBI shipboard medical records currently exist for U.S. forces serving in World War II, the last major naval conflict, nor is there an appropriate control group to compare with the Marines who fought in Southeast Asia. Nevertheless, accurate projections of disease rates during combat are required by the Deployable Medical Systems (DEPMEDS) program⁵ to ensure that adequate medical resources are available.

A recent study⁶ enumerated several factors potentially contributing to differences in disease rates between peacetime and wartime. These included degree of mobilization, amount of time available for sleep and personal

hygiene, availability of medical treatment, and stress levels. Not only are these factors expected to vary between combat and peacetime settings, but the dynamics may differ considerably between forces afloat and ashore. While the operational tempo during combat may be extremely high aboard ships as well as ashore, the degree of mobilization, distance from medical treatment, and stress levels associated with facing the unknown in unfamiliar territory are likely to be greater among ground troops than among their counterparts providing naval support. Consequently, the impact of combat operations on shipboard disease rates may indeed be different than the impact on land-based troops.

Analyses by Pugh⁶ projecting the effect of combat level on disease rates were constrained by the availability of applicable data. U.S. wartime disease records consist of aggregated data for the Navy and Marine Corps, which makes it impossible to accurately assess the effect of combat on forces afloat and ashore separately. However, medical records of shipboard populations of the British Royal Navy immediately before, during, and directly following World War II were found to exist. The goal of the present investigation is to contrast the rates of sick list admissions aboard ships involved in combat with the disease rates occurring aboard ships in peacetime settings. Ship type will first be examined as a factor in disease rates to determine whether the same trend evidenced among the different ship sizes within U.S. forces exists for the Royal Navy. The illness rates of ships participating in combat will be contrasted with similar ships deployed during peacetime to provide a reliable estimate of the effect of high intensity combat on DNBI incidence.

Method

A listing of Royal Navy ships attacked during World War II was obtained from H.M. Ships Sunk or Damaged by Enemy Action⁷. Two criteria were used in selecting ships to be used in the computation of DNBI rates during wartime: 1) that the vessels selected had to be involved in an enemy engagement in the time period under study, and 2) that any damage sustained to the ships involved in the engagements did not preclude it from continuing in action. Medical Officer's Journals (MOJs) archived at the Ministry of Defence at Hayes, Middlesex were examined and records extracted for seven carriers,

three battleships, nine cruisers, and 26 destroyers that were involved in combat between the years of 1940 and 1945. The MOJs were compiled on a quarterly basis and the records used in this study corresponded to three-month periods in which the deployed ships had engaged enemy forces. Each quarterly report contained a tabulation of the numbers and types of illnesses serious enough to require the afflicted crew member to be on the sick list for at least 48 hours.

Similarly, DNBI information was extracted from MOJs for ships deployed immediately preceding the war (1937-38) or following the cessation of hostilities (1946-47). Records from five carriers, two battleships, and thirteen cruisers were extracted from journals maintained during peacetime; no records from individual deployments of destroyers for the years surrounding the war era were available in the archives. Mean ship complements during the quarterly periods were also extracted from the MOJs. Appendix A lists the ships used in the analyses.

Disease and non-battle injury rates were computed as the number of cases per 1000 men per day. Separate rates were computed for the crewmembers aboard carriers, battleships, cruisers, and destroyers during the war, and aboard carriers, battleships, and cruisers in peacetime. For each "ship type by combat status" group, rates were calculated for 23 individual categories of illness. The specific disorders comprised by the illness categories are listed in Appendix B. Confidence limits were computed to determine if the rates differed significantly by ship type and combat status. The Dunn-Bonferroni method of adjusting for multiple comparisons⁸ was used in estimating the 95% confidence limits.

Results

Comparisons of sick list admissions between ship types indicated that the DNBI rates differed significantly by type of ship during the wartime deployments. The illness rate aboard aircraft carriers was 0.955 per 1000 men per day, while the rates aboard the other ship types were: battleships, 1.489; cruisers, 1.081; and destroyers: 1.575. The DNBI rates for both carriers and cruisers were significantly lower than the rates aboard battleships and destroyers. Table 1 is a display of the frequencies and rates for illness categories across the ship types. The rate of infectious

disorders was significantly lower on aircraft carriers than on battleships, cruisers, and destroyers. Additionally, the rate of digestive disorders was significantly lower on carriers than on battleships and destroyers. None of the other illness category differences between ship types reached a level of significance.

Because ship type was found to be a factor in rate of sick list admissions, comparisons between wartime and peacetime deployments were done separately for each type of ship. Computation of shipboard DNBI rates for the peacetime deployments indicated that the rates aboard carriers, battleships, and cruisers were all lower during wartime operations than during the periods of peace surrounding the war. Figure 1 is a column chart comparing the illness rates of the wartime and peacetime deployments by ship types.

Table 2 is a presentation of wartime and peacetime illness incidence by the individual disease categories. Aboard carriers, the rates of infectious disorders and parasitic diseases were significantly lower during wartime when compared to peacetime. Among battleships, the rate for skin disorders, as well as the overall DNBI incidence, was significantly lower during combat than on peacetime deployments. Comparisons of individual DNBI categories aboard cruisers indicated that the rate of generative system disorders, skin diseases, and general injuries were significantly lower during wartime deployments than in the periods of peace. The overall DNBI rate aboard cruisers was also significantly lower during the war period than on the peacetime deployments.

Discussion

Previous research had indicated that the rates of outpatient illness aboard U.S. Navy vessels were lower for combat support operations during the Vietnam conflict than in post-conflict periods². The current investigation sought to determine if this finding could be extended to more serious illness conditions than those measured by outpatient visits. The dependent measure in the present study was those DNBI conditions of a severity which warranted a minimum of 48 hours on the sick list. A further distinction between this and the previous study was that combat intensity was at a much

higher level among the afloat combatants in WWII than vessels providing support during Vietnam.

Rates of sick list admissions among ships of the Royal Navy deployed during wartime proved to be lower than those operating in peacetime. This finding applied to aircraft carriers, battleships, and cruisers with the differences reaching a level of statistical significance among the latter two. Though several major differences between this and the previous study exist, a recurring theme was that the rate of illness aboard carriers during war was only marginally lower than in peacetime, while the wartime rates of other ships were significantly lower during the combat deployments. Further, infectious disorder and parasitic disease rates on Royal Navy carriers were significantly lower during wartime when contrasted with peacetime operations, again paralleling a finding among outpatient visits of the Vietnam era study.

Both battleships and cruisers in the Royal Navy had significantly lower rates of skin disorders during combat deployments when contrasted with peacetime rates. Similarly, outpatient visits for skin disorders had been shown to be at significantly lower levels during Vietnam afloat operations than after the conflict. The other two significantly lower rates among disease categories in the present study occurred aboard cruisers for general injuries and generative system disorders. Though previously reported injury rates aboard smaller ships were higher after the Vietnam conflict than during hostilities, these rate differences were not significant; injury rates aboard carriers were in fact significantly higher during Vietnam operations than on post-conflict deployments. There was no illness category corresponding to generative system disorders among the Vietnam era data, so a valid comparison could not be made with that of the Royal Navy.

Among the DNBI rates on the four types of warships investigated during WWII, carriers had the lowest rate of illness overall, and this rate was significantly lower than both battleships and destroyers. A supplemental analysis of Royal Navy data indicated that carriers had significantly lower rates than battleships and cruisers during peacetime, as well. Again, this finding of lower illness rates on carriers than other vessels is consistent with outpatient visit patterns aboard U.S. Navy ships¹. A likely contributing factor to the lower rates on carriers is the fewer days these ships spend in port when compared with other ships. The large size of

carriers constrains the number of port dockings that these ships can safely maneuver; consequently, crewmembers aboard these vessels do not have as frequent of exposures to the people and conditions in foreign ports that may augment disease transmission and proliferation among their counterparts on smaller ships.

While the sick list admissions in the present study do not represent illnesses which would invariably require hospitalization if occurring ashore, they were of sufficient gravity to subject the afflicted crewmembers to a minimum of 48 hours of bed rest. As such, these illnesses provide a more valid index of disorders impacting the medical resources system than those maladies recorded as outpatient visits. Further, the rates in this study provide a clearer picture of the influence of combat conditions on shipboard disease rates than had previously been reported. That World War II was a high intensity conflict is beyond dispute; the comparisons of these wartime rates with those of peacetime deployments, then, should accurately reflect the potential differences in illness incidence between day-to-day operations and those of worst case battle scenarios.

Though the differences between afloat DNBI rates in wartime and peacetime were generally not great, all types of ships evidenced rate decreases during combat operations. This finding has important implications for medical resource planning. It appears that medical resources for personnel stationed aboard ships during wartime need only be supplemented according to the projected rate of battle casualties. Indeed, a recent study examining non-battle casualties and injuries (NBCI) among peacetime Royal Navy forces surmises that reduced port time among wartime task groups combined with reluctance to report sick during combat may offset the effects of battle stress on illness rates⁹.

The validity of generalizing from results based on the Royal Navy to U.S. forces is supported not only by the similar organizational structures and missions of the two navies, but also by parallels between these findings and those from U.S. Navy vessels during the Vietnam era. In both instances, forces afloat met the challenges of combat with no concomitant deleterious effects on the health of the crew members.

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TABLE 1. SICK LIST ADMISSION RATES AMONG SHIP TYPES; ROYAL NAVY, 1940-1945

<u>DISORDERS</u>	<u>CARRIERS</u>		<u>BATTLESHIPS</u>		<u>CRUISERS</u>		<u>DESTROYERS</u>	
	<u>N</u>	<u>RATE</u>	<u>N</u>	<u>RATE</u>	<u>N</u>	<u>RATE</u>	<u>N</u>	<u>RATE</u>
Infections	239	0.278	212	0.580*	276	0.468*	209	0.494*
Parasitic	97	0.113	18	0.049	71	0.120	67	0.158
Nervous System	23	0.027	5	0.014	23	0.039	37	0.087
Eye/Ear/Nose	33	0.038	21	0.057	20	0.034	16	0.038
Circulatory	6	0.007	8	0.022	9	0.015	3	0.007
Blood/Blood Forming	2	0.002	2	0.005	1	0.002	4	0.009
Glandular	1	0.001	0	0.000	0	0.000	0	0.000
Breast	1	0.001	0	0.000	0	0.000	0	0.000
Respiratory	29	0.034	8	0.022	31	0.052	26	0.061
Teeth & Gums	6	0.007	5	0.014	5	0.008	2	0.005
Hernia	6	0.007	4	0.011	3	0.005	6	0.014
Digestive	72	0.084	91	0.249*	72	0.122	94	0.222*
Nutrition/Metabolic	0	0.000	0	0.000	0	0.000	2	0.005
Generative System	19	0.022	17	0.046	6	0.010	12	0.028
Musculoskeletal	33	0.038	12	0.033	16	0.027	16	0.038
Skin	115	0.134	57	0.156	37	0.063	69	0.163
Urinary	5	0.006	4	0.011	4	0.007	7	0.016
Neoplasm	3	0.003	1	0.003	0	0.000	1	0.002
Alcoholism	0	0.000	2	0.005	0	0.000	0	0.000
Poisonings	2	0.002	0	0.000	4	0.007	4	0.009
General Injury	128	0.149	77	0.211	58	0.098	92	0.217
No Diagnoses	0	0.000	0	0.000	2	0.003	0	0.000
TOTAL	820	0.955	544	1.489**	638	1.081	667	1.575**
Mandays	858,519		365,397		590,280		424,432	

* rate is significantly higher than on carriers.

** rate is significantly higher than on cruisers.

TABLE 2. SICK LIST ADMISSION RATES DURING WARTIME AND PEACETIME DEPLOYMENTS

<u>DISORDERS</u>	<u>CARRIERS</u>		<u>BATTLESHIPS</u>		<u>CRUISERS</u>	
	<u>War</u>	<u>Peace</u>	<u>War</u>	<u>Peace</u>	<u>War</u>	<u>Peace</u>
Infections	0.278*	0.433	0.580	0.683	0.468	0.574
Parasitic	0.113*	0.248	0.049	0.076	0.120	0.102
Nervous System	0.027	0.010	0.014	0.015	0.039	0.022
Eye/Ear/Nose	0.038	0.023	0.057	0.071	0.034	0.056
Circulatory	0.007	0.002	0.022	0.031	0.015	0.012
Blood/Blood Forming	0.002	0.008	0.005	0.010	0.002	0.014
Glandular	0.001	0.004	0.000	0.000	0.000	0.000
Breast	0.001	0.000	0.000	0.005	0.000	0.001
Respiratory	0.034	0.030	0.022	0.056	0.052	0.032
Teeth & Gums	0.007	0.000	0.014	0.010	0.008	0.007
Hernia	0.007	0.002	0.011	0.000	0.005	0.003
Digestive	0.084	0.119	0.249	0.285	0.122	0.146
Nutrition/Metabolic	0.000	0.000	0.000	0.000	0.000	0.000
Generative System	0.022	0.040	0.046	0.010	0.010*	0.050
Musculoskeletal	0.038	0.006	0.033	0.010	0.027	0.022
Skin	0.134	0.094	0.156*	0.372	0.063*	0.186
Urinary	0.006	0.013	0.011	0.020	0.007	0.017
Neoplasm	0.003	0.006	0.003	0.031	0.000	0.004
Alcoholism	0.000	0.000	0.005	0.000	0.000	0.000
Poisonings	0.002	0.002	0.000	0.000	0.007	0.023
General Injury	0.149	0.094	0.211	0.403	0.098*	0.193
No Diagnoses	0.000	0.004	0.000	0.031	0.003	0.006
TOTAL	0.955	1.144	1.489*	2.120	1.081*	1.471
Mandays	858,519	470,250	365,397	196,200	590,280	693,228

* rate was significantly lower during wartime operations than on peacetime deployments.

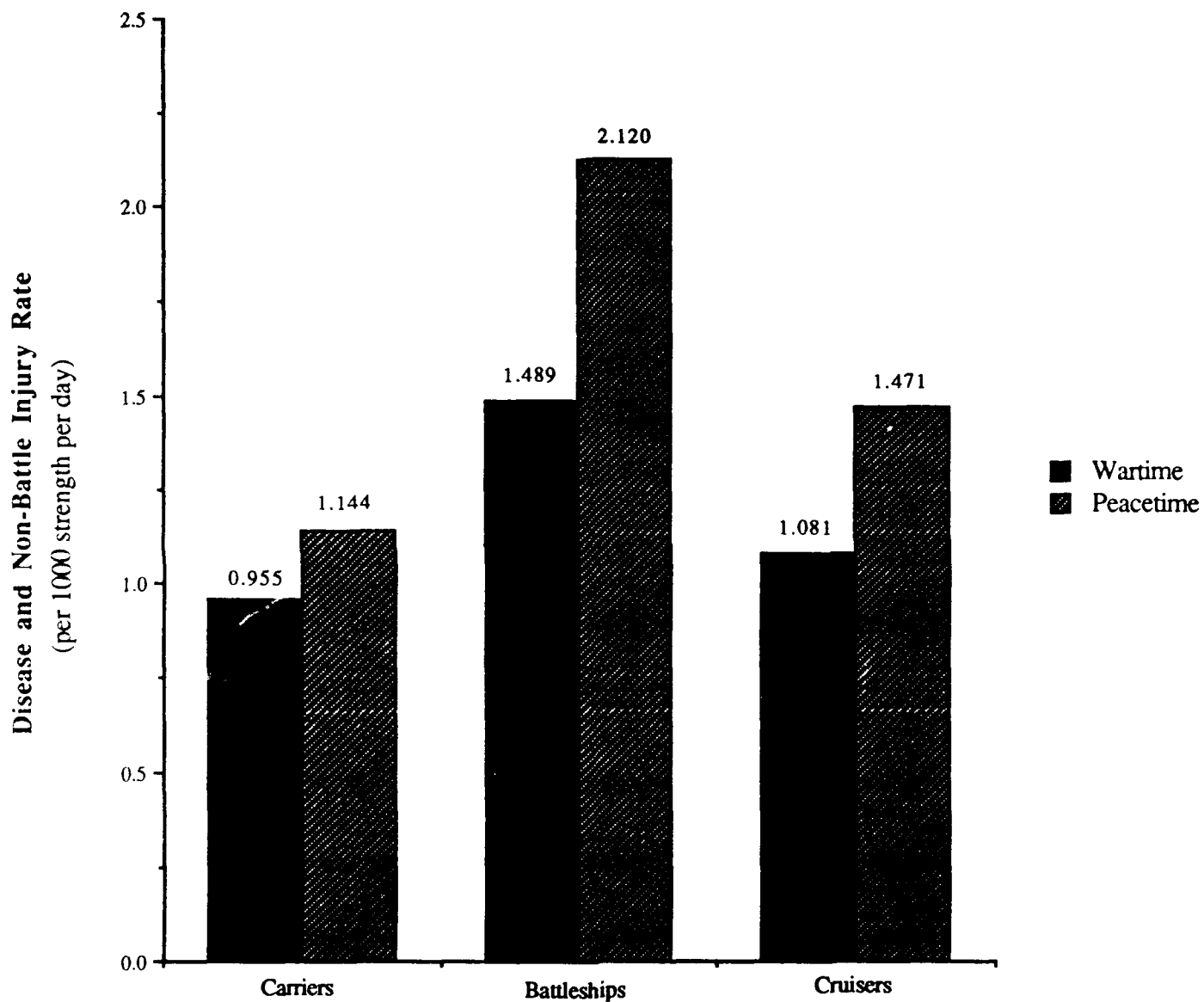


Fig. 1. Disease and Non-Battle Injury Sick List Admission Rates by Deployment Status and Ship Type; British Royal Navy

APPENDIX A

SHIPS OF WARTIME AND PEACETIME DEPLOYMENTS

Wartime		Peacetime
<u>Carriers</u>		<u>Carriers</u>
Formidable		Formidable
Furious		Furious
Illustrious		Illustrious
Indomitable		Indomitable
Pegasus		Victorious
Victorious		
<u>Battleships</u>		<u>Battleships</u>
Malaya		Malaya
Rodney		Rodney
Valient		
<u>Cruisers</u>		<u>Cruisers</u>
Argonaut		Arethusa
Aurora		Argonaut
Berwick		Aurora
Cleopatra		Berwick
Enterprise		Birmingham
Kenya		Cleopatra
Mauritius		Enterprise
Sirius		Kenya
Sussex		Mauritius
		Orion
		Penelope
		Sirius
		Sussex
<u>Destroyers</u>		
Albrighton	Ledbury	
Anthony	Liddesdale	
Beaufort	Lively	
Bulldog	Nubian	
Cleveland	Obedient	
Diamond	Quality	
Fame	Quillian	
Firedrake	Quorn	
Griffin	Ripley	
Hero	Southdown	
Jackal	Windsor	
Kimberley	Zambesi	
Lamberton		

APPENDIX B

DISEASE CATEGORIES AND SPECIFIC DISORDERS WITHIN EACH CATEGORY

INFECTIONS

- Chicken Pox
- Common Cold
- Cow Pox
- Dengue
- Diphtheria
- Dysentery
- Enteric Fever, Typhoid
- Enteric Fever, Paratyphoid
- Erysipelas
- Influenza
- Malaria
- Measles
- Meningococcal Infection
- Mumps
- Pneumococcal Infection (lungs)
- Pneumococcal Infection (other)
- Pyogenic Infection
- Pyrexia of Unknown Origin
- Rheumatic Fever
- Rheumatism, sub-acute
- Rubella
- Sandfly Fever
- Scarlet Fever
- Small-pox
- Tonsillitis
- Tuberculosis (pulmonary)
- Tuberculosis (non-pulmonary)
- Undulant Fever
- Chancroid
- Chancroid Sequelae
- Syphilis (first record)
- Syphilis (later record)
- Gonococcal Infection, acute
- Gonococcal Infection, sequelae
- Lymphogranuloma, inuinale
- Other diseases caused by Infection

DISEASES CAUSED BY METAZOAN PARASITES

DISEASES OF THE NERVOUS SYSTEM

- Diseases of Spinal Cord
- Diseases of Brain
- Apoplexy
- Paralysis
- Epilepsy
- Neurasthenia
- Other Nervous Diseases (including Mental)

DISEASES OF THE EYE

DISEASES OF THE EAR

DISEASES OF THE NOSE

DISEASES OF THE CIRCULATORY SYSTEM
 Diseases of the Heart (Organic)
 Diseases of the Heart (Functional)
 Diseases of the Arteries
 Diseases of the Veins
 DISEASES OF THE BLOOD AND BLOOD-FORMING ORGANS
 DISEASES OF GLANDS AND INTERNAL SECRETION
 DISEASES OF THE BREAST
 DISEASES OF THE RESPIRATORY SYSTEM
 Diseases of the Larynx
 Bronchial Catarrh
 Bronchitis
 Asthma
 Fibrosis of Lung
 Pleurisy
 Other Respiratory Diseases
 DISEASES OF TEETH AND GUMS
 HERNIA
 Hernia Recurrent
 DISEASES OF THE DIGESTIVE SYSTEM
 Mouth, Palate, Fauces, Pharynx
 Peptic Ulcer, Gastric
 Peptic Ulcer, Duodenal
 Appendicitis
 Other Diseases of the Stomach
 Other Diseases of the Intestines
 Diseases of the Rectum and Anus
 Diseases of the Liver
 Other Digestive Diseases
 DISEASES OF NUTRITION OR METABOLISM
 Scurvy
 Beri-Beri
 Gout
 Diabetes
 Other Diseases of Nutrition
 DISEASES OF GENERATIVE SYSTEM
 Stricture
 Varicocele
 Orchitis
 Other Diseases of Generative System
 DISEASES OF BONES, JOINTS, MUSCLES, FASCIAE, AND BURSAE
 Periosteum and Bone
 Cartilage and Joints
 Spine
 Muscles, Fasciae, Tendons, Bursae
 Deformities and Congenital Malformations
 DISEASES OF AREOLAR TISSUE AND SKIN
 Abscess
 Boil
 Eczema
 Impetigo
 Other Diseases of Areolar Tissue and Skin

DISEASES OF URINARY ORGANS

Kidneys

Ureter and Bladder

Urinary Disorders

NEOPLASMS

New Growths, Malignant

New Growths, Non-malignant

ALCOHOLISM

POISONING, VARIOUS

GENERAL INJURIES

Multiple Injuries

Multiple Burns and Scalds

Heat Stroke

Suffocation-Drowning

Suffocation, -effects of

Compressed Air Disease

Burns and Scalds

Injuries and Wounds

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